BASIC AIRWAY MANAGEMENT

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This is the first module in a series on management of airway and ventilation in critically ill patients.

Introduction

In the initial assessment and management of any critically ill patient the ABC's (**A**irway, **B**reathing and **C**irculation) are the first priority. Hypoxia will begin to cause irreversible brain injury within approximately 5 minutes and so airway management must precede any other treatment.

The ability to establish and maintain an open airway in a patient, and the ability to ensure adequate ventilation and oxygenation of the patient, are therefore essential skills for physicians. For the purposes of this module "basic airway management" will refer to those basic interventions that maintain an open airway and assist ventilation but do not include endotracheal intubation.

Recognizing inadequate airway and ventilation

This is the first thing that doctors need to recognize— compromised airway and inadequate ventilation.

Adequate ventilation involves two factors

1. Adequate intake as well as adequate exhalation of air – This indicates that there is enough tidal volume going into the patient as well as coming out.
2. Adequate respiratory rate.

The combination of these provides adequate oxygen for gas exchange as well as allows removal of carbon dioxide. Any problem with these two processes will cause inadequate oxygenation and ventilation.

So what are the reasons of inadequate ventilation? The most common reasons are airway obstruction or inadequate respiratory effort or a combination of the two.

Airway obstruction:

Airway obstruction results in hypoventilation, increased work of breathing and impaired gas exchange in the lungs. If this is not recognized in time and treated adequately, it can result in development of hypercarbia and ultimately hypoxaemia. Provision of supplemental oxygen (using a mask or nasal canula) when there is an airway obstruction will not resolve the problem of hypercapnia associated with hypoventilation and impaired alveolar ventilation.

Obstruction may be partial or complete, depending on the mechanism or cause. Complete airway obstruction will rapidly cause hypoxia and cardiac arrest, whereas partial obstruction may be more insidious in onset.

Recognizing airway obstruction

Some of the important signs of airway obstruction are:

1. **Noisy breathing:** This is the hallmark of a compromise in upper airway. It is indicative of partial obstruction that can lead on to total obstruction. Noisy breathing may be in the form of snoring, gurgling (blood, vomit or secretions) or stridor.
2. **Use of accessory muscles** of respiration, agitation
3. **Expiratory wheeze** (indicative of lower respiratory tract obstruction)

Recognition of airway compromise, as seen from the above description is primarily based on observation and listening to the patient. A decrease in saturation is a late indication of ventilation and oxygenation. If one waits till the saturation decreases below 90%, significant damage due to hypoxia would have already occurred. **Dependence on the reading from a saturation probe should never substitute for looking and listening to the breathing of a patient.**

Causes of airway obstruction: (1)

1. **Obtundation of consciousness**: In low level of consciousness, the cause of the obstruction will often be the result of the tongue falling back into the posterior pharynx due to loss of tone in the submandibular muscles.
2. **Intraluminal contents**: Pooled secretions, blood, vomitus and foreign bodies (Eg. Broken tooth in trauma)
3. **External compression**: Haematoma, tumour, goitre
4. **Direct trauma:** Blunt trauma to maxilla, larynx, mandible, burns, smoke inhalation
5. **Artificial airways:** Blockage or displacement of tracheostomy, displacement of tracheal stent
6. **Excessive granulation tissue:** Prolonged mechanical ventilation, tracheal stenosis, supraglottic stenosis
7. **Neuromuscular disorders:** myasthenia gravis

Management of obstructed airway

Once obstruction of the airway is detected, immediate measures have to be taken to discover the cause and to maintain the airway. Delay can lead to dangerous hypoxemia and cardiac arrest.

Opening up and maintaining an obstructed airway may require one or more of the following measures:

1. Physical manoeuvres – like head tilt-chin lift or jaw thrust
2. Suctioning – to remove debris and foreign bodies
3. Positioning
4. Airway adjuncts
5. Endotracheal intubation

If the patient is making respiratory effort but is not adequately ventilating his/her chest because of airway obstruction the doctor must determine the cause and take immediate measures to alleviate the obstruction.

In an unconscious patient, the cause of the obstruction will often be the result of the tongue falling back into the posterior pharynx due to loss of tone in the submandibular muscles. This problem can be quickly corrected using a simple maneuver such as a head tilt-chin lift or jaw thrust and this may be all that is needed to open the airway and allow adequate chest ventilation. If the physician encounters noisy or "gurgling" respirations at this point, the upper airway should be suctioned for vomitus and excess secretions.

In patients with a low level of consciousness (Eg. Head injury), the airway may be maintained by proper positioning (semi-prone position) to prevent the tongue from falling back and obstructing the airway in the supine position.

Endotracheal intubation is the definitive intervention in the management of an obstructed airway as it not only provides passage for air, but also protects the trachea from further obstruction due to pooling of secretions etc. Endotracheal intubation will be discussed in the next module.

Some of the simple interventions to maintain airway in a critically ill patient are described below.

Simple airway manoeuvres

Head Tilt-Chin-Lift:

This manoeuvre should only be used if the physician is confident there is no risk of injury to the cervical spine. Standing on the patient's right hand side,

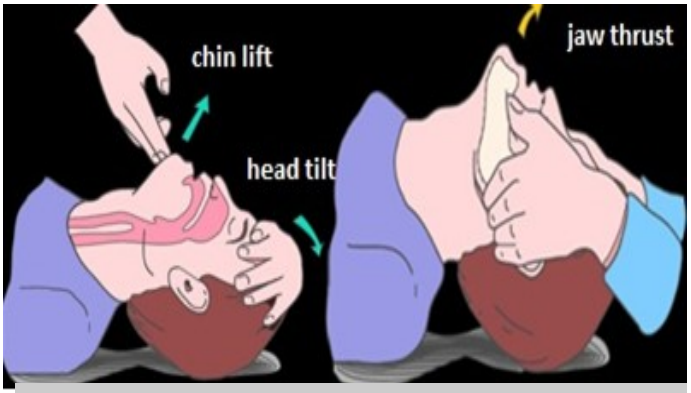


Fig.1: Chin-lift and jaw thrust manoeuvres

the doctor's left hand is used to apply pressure to the forehead to extend the neck. The volar surfaces of the tips of the index and middle finger are used to elevate the mandible, which will lift the tongue from the posterior pharynx. (Fig.1)

Jaw-Thrust:

Where there is risk of cervical spine injury, such as a patient who is unconscious as a result of a head injury, the airway should be opened using a manoeuvre that does not require neck movement. The jaw thrust is performed by having the physician stand at the head of the patient looking down at the patient. The middle finger of the each hand is placed at the angle of the patient's jaw on both sides. An upward pressure is applied to elevate the mandible, which will lift the tongue from the posterior pharynx. (Fig.1)

Positioning

In patients with a poor level of consciousness due to any cause, airway obstruction is usually because the tongue falls back in the supine position and partly obstructs the upper airway. If endotracheal intubation is not being considered, (Eg. mild to moderate head injury), the airway in these patients can be maintained by semi-prone positioning. The patient lies on the side with the chest supported by pillows and head facing down. Instability of the cervical spine will have to be ruled out before positioning.

Airway adjuncts

Once the airway is open, an oropharyngeal or nasopharyngeal airway may need to be inserted to make it easier to maintain an open airway. Both of these devices prevent the tongue from occluding the airway and thereby provide an open conduit for air to pass. It is important to note that these two airway devices, unlike a cuffed endotracheal tube, **will not protect the trachea from aspiration** of secretions or stomach contents. If a patient is unable to protect their own airway, they should have an endotracheal tube inserted as soon as possible by someone with training and expertise in that skill.

1. Oropharyngeal airway

The oropharyngeal airway is essentially a curved hollow tube that is used to create an open conduit through the mouth and posterior pharynx. A rough guide for choosing the correct size is to hold the airway beside the patient's mandible, orienting it with the flange at the patient's mouth and the tip at the angle of jaw. The tip should just reach the angle of the jaw. While inserting the airway avoid pushing the tongue into the posterior pharynx. This can be accomplished by starting with the curve of the airway inverted, and then rotate the airway as the tip reaches the posterior pharynx. Alternatively a tongue depressor can be used to move the tongue out of the way as the airway is passed. Whichever technique is chosen the physician must be certain that the airway is indeed in the right position. If there are problems ventilating the patient after insertion of the airway then it should be removed and reinserted.

Fig.2: Oropharyngeal airway - Assessing size (2)

2. Nasopharyngeal airway

The nasopharyngeal airway is a soft rubber or plastic hollow tube that is passed through the nose into the posterior pharynx. To measure the length of the airway, measure the distance from the tip of the nose to the tip of the tragus. The diameter of the airway should also be measured and it should be little less that the diameter of the patient nares. The nasopharyngeal airway is generally better tolerated than the oropharyngeal airway in a semiconscious patient.

The nasal airway is well lubricated with lignocaine jelly and inserted with the bevel toward the septum.

While a nasopharyngeal airway may be left in place**, an oropharyngeal airway should only be used as a temporary measure to keep the airway open before definitive management like endotracheal intubation.** This is because the oropharyngeal airway does not protect the trachea and also prevents the patient from swallowing and if left in place for long periods (especially in a patient who is able to swallow), it only quickens the process of pooling of secretions and aspiration

Fig.3: Assessing size of naso-pharyngeal tube (3)

Fig.4: Insertion of nasopharyngeal airway

Bag-mask ventilation

A patient who is not able to breathe adequately on their own will require support of their breathing through artificial means. In order to push oxygen rich air into the patient's chest, some form of positive pressure ventilatory assistance is required. The technique of bag-mask ventilation is difficult even in the best of hands and will require considerable practice before it can be done effectively on a patient. However, if mastered, this can be lifesaving in an emergency.

Fig. 5: Bag-mask ventilation (two-person technique) (5)

The first step in bag-mask ventilation is to select a mask that will cover the mouth and nose of the patient and create a tight seal. The mask is then attached to the bag device, which should be attached to high flow oxygen (15L/min.) such that the reservoir of the bag is fully inflated.

Two-person technique

The biggest challenge in bag-mask ventilation is maintaining an open airway and a tight seal using one hand. If a second person is available, it is recommended that one person manages the mask and the airway, while the second person squeezes the bag to ventilate the chest. The person responsible for the mask stands at the head of the bed and places his thumbs on the top surface of the mask. The remaining fingers are then used to grip the mandible on either side. The mask is squeezed between the thumbs and the fingers to create a seal and at the same time the mandible is elevated to open the airway. This technique is considerably easier, but again, the doctor must be constantly checking that air is flowing easily into the patient and that the chest is rising and falling. The rate of ventilation should be about 12 – 15 breaths per minute. In a cardiac arrest, the rate of respirations is 1 breath every 6-8 seconds. In a respiratory arrest, the rate of respirations is 1 breath every 5-6 seconds.

If there is obstruction to air flow or the chest does not rise, recheck to make sure that there is a tight seal to the face, that the mandible is being elevated to open the airway and, if an artificial airway is being used, that it is in place. Readjust the mask and try again.

Steps toward assessing the airway (Basic Life Support protocol):

Step 1: Assess responsiveness

Use the "shake and shout" technique to assess responsiveness. At the same time scan the chest for breathing. If the patient is unresponsive and not breathing, proceed to the next step. If the patient is breathing proceed to step 4.

Step 2: Call for help

In all resuscitation situations, the first one on the scene will require assistance and hence the importance of this step. At this point you must ask for a monitor with facility for SpO2, non-invasive blood pressure and ECG monitoring, a defibrillator and personnel to come and assist with resuscitation.

Step 3: Check pulse

If there is no pulse, start chest compressions immediately and follow the basic life support protocol. If pulse is present and the patient is not breathing proceed to the next step.

Step 4: Open the airway

Noisy breathing is indicative of an obstructed airway. Ensure an open airway using the techniques described earlier.

Step 5: Ventilate chest

In the absence of spontaneous respiration, the rescuer should immediately ventilate the chest and watch for adequate chest rise using the two-person technique. Remember, adequate chest ventilation is the single most important determinant of patient outcome in an apneic patient. Continue ventilating till help arrives and definitive care with endotracheal intubation can be performed. If you are the only one at the scene, ask a nurse to gather the equipment for endotracheal intubation and perform it, while continuing mask ventilation.

Fig. 6: Holding mask in two-person technique (6)

Sources:

1.Managing airway obstruction. British Journal of Hospital Medicine, October 2012, Vol 73, No 10

2.Image from http://www.haworth21.karoo.net

3.Image from http://little-medic.blogspot.in

4.Essentials of Critical Care – 8th Ed. Division of critical care, CMC Vellore.

5.Image from http://www.cuhk.edu.hk/

6.Image from http://emedicine.medscape.com/article/80184-overview#a15

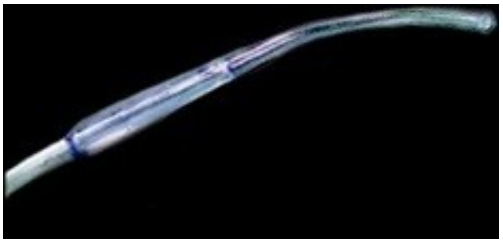
Suggested material for the Equipment Tray

1. Gloves

The rescuer should at all times avoid direct contact with the blood and other body fluids of the patient. If available, gloves should be worn during all airway management procedures.

2. **Suction apparatus**

In most resuscitation situations, the patient will either vomit, or at the very least, have an excess of secretion in their oropharynx. If available, a suction catheter should be included as part of your basic airway equipment.



3. Lubricant

If a nasopharyngeal airway is used, it will require lubrication of its outer surface prior to insertion. Xylocaine Jelly is used because it is a good lubricant and it reduces irritation through its local anaesthetic effect.

4. Nasopharyngeal Airway

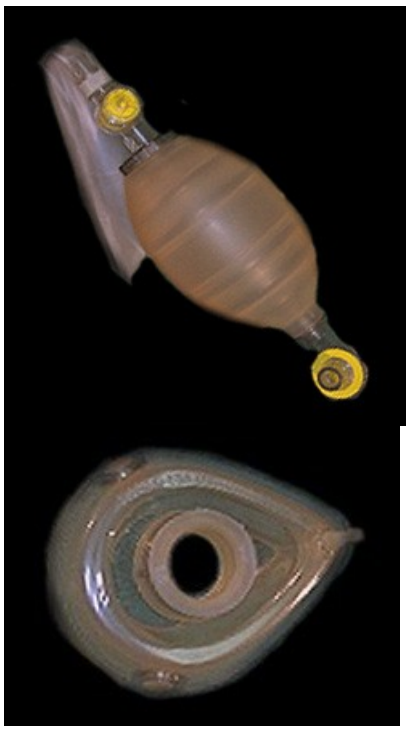
The nasopharyngeal airway is made of soft, pliable plastic, and is inserted through the nares and into the nasopharynx, thus providing a patent airway to facilitate chest ventilation. It has the advantage of being better tolerated in the conscious or semi-conscious patient than the oropharyngeal airway. It is also easier to insert in a patient who has his/her teeth clenched. It is important to note that the NP airway does not protect the airway from aspiration of vomitus.

5. Oropharyngeal Airway

The oropharyngeal airway is a rigid plastic device, which is inserted through the mouth into the oropharynx. This provides a patent airway to facilitate chest ventilation. It is important to note that the oropharyngeal airway does not protect the airway from aspiration of vomitus.

6. Bag-Valve Ventilator

The bag-valve ventilator is a device designed to ventilate the chest. By attaching an oxygen supply, it can be used to ventilate the chest with a high concentration of oxygen. The bag-valve ventilator can be used with a mask, as in basic airway management, or it can be attached to an endotracheal tube as part of advanced airway management.



7. Mask

Masks are used to provide a tight seal between the patient's face and the bag-valve ventilator. Masks come in various sizes. The correct size of the mask for a particular patient should provide a tight seal around the nose and mouth. The pointed end of the mask creates a seal over the bridge of the patient's nose, while the round end creates a seal between the lower lip and chin.